



# Incidental sightings and local ecological knowledge on *Cardisoma carnifex* (Herbst, 1796) from the Andaman Islands

M. Jaini<sup>1, 2\*</sup>, J. Horo<sup>1</sup> and N. Namboothri<sup>1</sup>

<sup>1</sup>Dakshin Foundation, Sahakar Nagar, Bangalore- 560 092, Karnataka, India.

<sup>2</sup>TG 2B 1/12 Garden Estate, Gurgaon-122 002, Haryana, India.

\*Correspondence e-mail: [jainimahima@gmail.com](mailto:jainimahima@gmail.com)

Received: 17 Jan 2021 Accepted: 10 Mar 2022 Published: 23 Apr 2022

Short Communication

## Abstract

The land crab *Cardisoma carnifex* is widely distributed along the Indian and Pacific Ocean coasts. Despite contributing to the diet of local, often marginalized communities, there is limited information available on its biology, ecology and harvest. In this communication, incidental observations on the reproductive ecology of the species and the results of some preliminary interviews with local community members regarding the harvest of the species and associated Local Ecological Knowledge (LEK) are summarized. Field observations indicated that this species is reproductively active during the southwest monsoon season and larval release is nocturnal, synchronised with the full moon and spring high tide. Members of the Ranchi and Karen communities provided concurring information on its behaviour and noted that larval release happens only at night during the monsoon months. It is found that Ranchi communities in Andaman harvest *C. carnifex* at the time of mass larval release, but not the Karen communities. Larval release by *C. carnifex* in the Andaman Islands likely varies spatially with adult densities and is synchronised with the monsoon, lunar phase and nocturnal spring high tides.

**Keywords:** Land crab, Local Ecological Knowledge, *Cardisoma carnifex*, Andaman Islands

## Introduction

The brown land crab *Cardisoma carnifex*, is widely distributed along the Red Sea and East Africa, through the Indian Ocean, up to the Pacific Islands (Burggren and McMahon, 1988; Carpenter and Niem, 1998). In India, it has been reported along the west coast, Lakshadweep and Andaman and Nicobar Islands (Alcock, 1900; Sankarankutty, 1962; Kannupandi *et al.*, 1980; Devi *et al.*, 2019). Though the occurrence of *C. carnifex* in the Andaman

Islands is common, scientific reports from this region are scant (Silas and Sankarankutty, 1960; Sankarankutty, 1962). Land crabs can often occupy the top of the energy pyramid in tropical islands devoid of large predators. The *C. carnifex* occurs close to the shore, in low-lying areas, near water or wet mud, living in burrows that either contain water or that are influenced by the tides (Silas and Sankarankutty, 1960; Cameron, 1981; Burggren and McMahon, 1988). Nocturnally active, they avoid desiccation by sheltering in burrows or staying hidden in crevices, under tree roots, logs and leaf litter (Alcock, 1900; Grubb, 1971). They play an important ecological role as herbivores, scavengers and detritivores. The *C. carnifex* is known to consume leaf litter, fresh shoots, seeds, bird and reptile faeces (Grubb, 1971; Alexander, 1979). Land crabs form an effective barrier against invasion by exotic plant species (Burggren and McMahon, 1988). In the Line Islands of the Central Pacific, *C. carnifex* is an important dispersal agent for screwpine (*Pandanus*) seeds (Lee, 1985).

Like other land crabs of marine origin, the females of *C. carnifex* return to the sea to release larvae. The timing of this migration often coincides with the rainy season (Grubb, 1971; Chen, 2012). Although they might release larvae in freshwater, research has shown that the first zoeal stage cannot survive freshwater (Chen, 2012). Data on the timing of the larval release of the species is limited. Crabs in Aldabra, Tamil Nadu (India) and Lizard Island (Australia) show lunar periodicity, migrating ashore within a few days of the new moon or full moon, releasing the planktonic larvae at night (Grubb 1971; Kannupandi *et al.*, 1980; Quinn *et al.*, 1991). While in other regions like Taiwan and Japan, this species demonstrates a semi-lunar periodicity (Chen, 2012; Doi *et al.*, 2018). The *C. carnifex* is the most frequently collected gecarcinid species in the Indo-West Pacific (Carpenter and Niem, 1998). These crabs are likely harvested where ever they occur in high densities, but accounts of their use are limited to certain

regions. Often caught by hand or with special traps, this species fetches a low market value and is mainly caught for local use in the Philippines (Barnwell *et al.*, 1982; Subang Jr. *et al.*, 2020) and Christmas Island (Kronen, 2007). After harvest, these crabs are maintained in enclosures, fed on rich diets to fatten them and flush out any toxins associated with their natural herbivorous diet (Carpenter and Niem, 1998; Mathews, 2002). In Palau, market-driven overexploitation of the species has resulted in a ban on its exports and prohibition of harvest within three days of the full moon larval release period (Mathews, 2002).

The Andaman Islands are home to both indigenous and settler tribes. In this study, we interviewed Ranchi and Karen settlers, given their history and occupational roles in the Andaman Islands. Starting in the early 1920s, tribal people from the Chotanagpur region in central India, collectively termed Ranchi and the Karen communities from Myanmar were settled as forest labourers in different parts of the Andaman Islands (Heidemann and Zehmisch, 2016; Maiti, 2004). Today, Ranchi and Karen settlers are often employed in the government forest departments or as field assistants in environmental and ecological research, as they are a valuable source of information on natural history matters (Mohanty and Chakravarty, 2018). Their wealth of LEK regarding Andaman forests and seas made them vital to this study. The *C. carnifex* larval release, local knowledge and community harvest findings from the Andaman and Nicobar Islands are reported in this communication.

## Material and methods

The Andaman archipelago consists of 556 islands, islets and rocks. Over 80% of the 6408 km<sup>2</sup> land area is protected, sanctuaries and reserve forests (Department of Environment and Forests, Andaman and Nicobar-website, 2020). The islands contain lush tropical deciduous and evergreen rainforests that transition into littoral forests and mangroves along the coastline. Receiving an average of 3000 mm of rainfall annually, the islands provide ideal habitat for the humidity-loving gecarcinids.

The Andaman Nicobar Environment Team (ANET), a field research base located in North Wandoor, South Andaman Island, lies within 100-400 meters of the high tide line. Home to tropical rainforests, ANET neighbours the Lohabarrack Crocodile Sanctuary, which contains rich littoral and mangrove ecosystems with sandy shorelines (Fig. 1). Berried *C. carnifex* larval release observations were incidental while the ongoing field-based research activities. The *C. carnifex*'s large size, large eyes and pale claw colouration sets it aside from the other similar-looking gecarcinids found in the Andaman Islands. Data on tides, lunar phase and environmental conditions were noted in addition to crab behaviour. Due to the rarity of the land crab observations, we conducted informal interviews with key informants belonging to

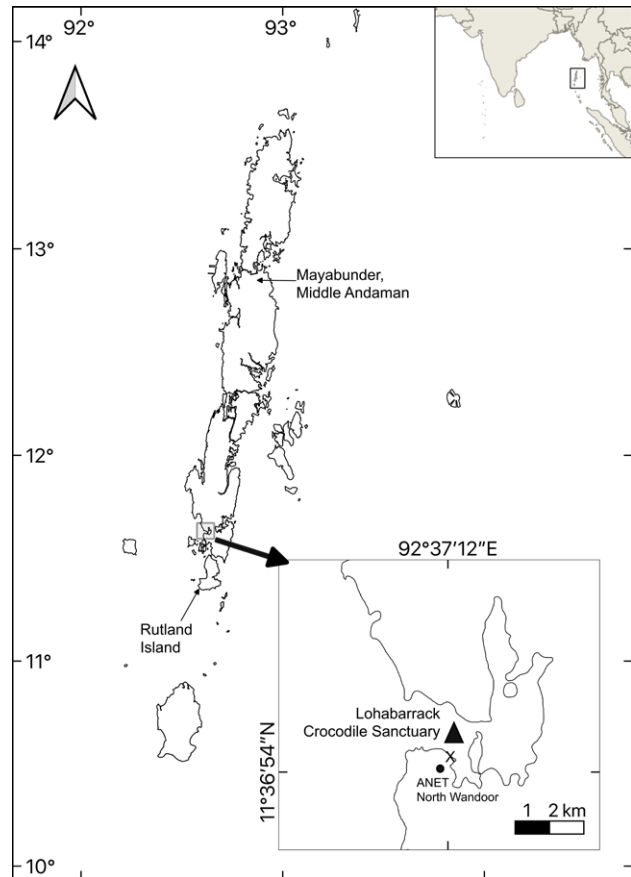


Fig. 1. Map of the Andaman Islands indicating the study regions. The location of the May 2019 berried *C. carnifex* larval release sighting on the North Wandoor beach is marked X.; the field-research site within the bay (▲) and the ANET field station (●)

the Ranchi community from Rutland Island ( $n=4$ ) and the Karen from Mayabunder, Middle Andaman Island ( $n=2$ ). Interviews were open-ended and aimed at understanding the types of land crabs found in the Andaman Islands, their behaviour, reproductive habits, and interest in the harvest.

## Results and discussion

### Primary observations

Burrows of the *C. carnifex* are commonly observed in the littoral forest surrounding ANET as well as along the shoreline of the North Wandoor beach. Since October 2018, berried females were recorded on three different dates; some incidental to our research work and others accidentally at the ANET base (Table 1). On the full moon night of 19 May 2019, three berried *C. carnifex* females of approximately 8-10 cm carapace width were recorded on the beach sand under the *Casuarina* trees and amidst *Ipomoea* plants within 1-2 meters of the high tide line (Table 1). Over an hour later, 2 berried females were found to release larvae into the seawater. All observations

Table 1. Details of berried *C. carnifex* recorded along with information on lunar phase and high tide.

Location	Observation	Date/ Time of observation	Lunar phase	High tide time and height (m)	Largest nocturnal high tide of the month [Date, time and height (m)]
Beach, North Wandoor	Three berried females outside burrows	19 May 2019 7:40-7:50 PM	Full Moon	9:27 PM; 1.99m	18 May 2019; 8:50 PM; 2.01m
Beach, North Wandoor	Two berried females releasing larvae in seawater	19 May 2019 9:00-9:10 PM	Full Moon	9:27 PM; 1.99m	18 May 2019; 8:50 PM; 2.01m
ANET, North Wandor	One berried female outside burrow, heavy rain	31 Aug 2019 9:00-9:10 PM	1 day after New Moon	9:52 PM; 2.28m	31 Aug 2019; 9:52 PM; 2.28m
ANET, North Wandor	one berried female outside burrow, heavy rain	18 Sep 2020 9:00-9:30 PM	1 day after New Moon	9:46 PM; 2.36m	19 Sep 2020; 10:24 PM; 2.39m

were within 10 meters of 11°37'11"N and 92°37'12"E (Fig. 1, Table 1). To hatch their eggs, they vigorously shook themselves with abdomens immersed in the seawater, hind legs on the sand and claws extended. This was the only observation of *C. carnifex* on the beach between November 2018 and October 2019, during the 105 trips to the shoreline. On two separate occasions, we accidentally observed berried *C. carnifex* females approximately 10 cm in carapace width near the ANET dining area (Table 1, Fig. 2). Although these observations were over a year apart, both occurred a day after the new moon, amidst heavy rain and within one hour before the high tide. In both cases, the crabs appeared disoriented and did not release larvae. All berried females were recorded within a day of the highest nocturnal spring tide for that month (Table 1). Coinciding the larval release with the largest tidal amplitude, nocturnal high tides, is advantageous to intertidal crabs (Morgan and Christy, 1995). Larger tides allow the egg-bearing female land crabs to release larvae closer to the highest tide line, reducing the amount of time they are in the seawater and thus reducing the risk of being preyed on by shore fishes (Alexander, 1979) and the strong water motion rapidly transports the newly hatched larvae away from the shore. Tidal amplitudes vary not only as a factor of moon phase but also position, regional bathymetry and

local obstructions. Thus, local tidal amplitudes can help explain range-wide lunar differences in *C. carnifex* larval release timing.

### Local knowledge

Ranchi community members from Rutland Island call the land crab 'Mahua Kekra' as it is often found burrowing near the Andamans sea mahua tree (*Manilkara* or *Mimusops littoralis*) and 'kekra' is the generic term for crab in Hindi. All informants noted that these crabs are often found near the shore, living in sand burrows, under leaf litter or logs and roots in the littoral forest. Two out of the four informants shared that the berried crabs emerge only at night, during the southwest monsoon season (May through September). Although these two informants haven't engaged in *C. carnifex* harvest over the past 4-10 years, they shared that their community harvests them once a year when berried females go to the shore to hatch their eggs. They both noted that in the past, people were able to capture approximately 40-120 crabs at a time. Crabs can be kept alive for up to a week, cooked and eaten as required. This is unlike the *C. carnifex* harvest on Christmas Island, which seems unrelated to larval release migrations (Kronen, 2007). While in Palau, a similar harvest of *C. carnifex* during their larval release migrations, but driven by market demand, has led to significant declines (Mathews, 2002).



Fig. 2. Berried *C. carnifex* from ANET, 100 meters inland of the nearest high tide line

Karen informants from Mayabunder noted two different kinds of land crabs in Middle Andaman. The first has different sized claws (*C. carnifex*) and the other has redder in colour. One Karen informant said that the red one is similar to that found in Campbell Bay, Great Nicobar Island. These observations are consistent with the new species *Discoplax magna*, which was earlier misidentified as *D. hirtipes* (Ng and Shih, 2014). Both types of land crabs are called *Swe-Khon(g)-Che(n)* in the Karen language, where *Swe* means crab and *Khon(g)-Che(n)* refers to their leaf-eating nature. The informant also noted that only *C. carnifex* is seen in the ANET Wandoor region. One informant mentioned that egg-bearing females are seen during the monsoon months (May through September), particularly on full moon nights but denied the harvest and consumption of land crabs by Karen people. The other noted that recently Karen

community members occasionally harvest land crabs and eat them while on picnics. Our Karen interviewees did not share any accounts of mass larval release events.

Of the five species of gecarcinids found in the Andaman and Nicobar archipelago (Alcock, 1900), *Cardisoma carnifex*, *Discoplax magna* (Ng and Shih, 2014) and *Gecarcoidea humei* (Lai *et al.*, 2017) are larger. The other large gecarcinid genera show different reproductive behaviour from that of *C. carnifex* (Grubb 1971; Quinn *et al.*, 1991; Chen, 2012). The small eyed *Gecarcoidea lalandii*, for example, does not enter seawater to release larvae; females simply drop the egg mass into the ocean while perched on rocks (Liu and Jeng, 2007). *Discoplax hirtipes* on the other hand immerse themselves in seawater before mating and ovulation, and this 'dipping' behaviour proves to be the most opportune time for harvest in the Solomon Islands (Foale, 1999). After mating, females come into berry while sheltering in burrows and larvae are released 3-4 weeks later (Foale, 1999).

This communication provided the first report of *C. carnifex* larval release and harvest in the Andaman Islands. Differences in local knowledge and harvest patterns by Ranchi and Karen communities may be due to geographic variations in resource availability or cultural preferences. Larval release coinciding with full moon nights was observed in Parangipettai, Tamil Nadu as well (Kannupandi *et al.*, 1980) and their limited nutritional value may account for the lack of local harvest on India's coast (Lyla *et al.*, 2016). Our observations provide a baseline and can help direct further research on the spatial distribution of gecarcinid species, their ecology and existing harvest patterns for the sustainable management of land crab fisheries in the Andaman and Nicobar Islands.

## Acknowledgements

We would like to thank Hsi-Te Shih and Peter K. L. Ng for helping to confirm our identification of *C. carnifex*. Community informants shared vital information on land crabs and we are grateful for their involvement with this study. The Andaman Nicobar Islands Department of Environment and Forests, Office of the Principal Chief Conservator of Forests (Wildlife) provided permits to conduct research in the Lohabarrack Crocodile Sanctuary (No. CWLW/WL/134(D)/272). We would also like to thank two anonymous reviewers, whose feedback helped to improve this manuscript.

## References

Alcock, A. 1900. Materials for a carcinological fauna of India. No. 6. The brachyura catometopa or grapsoidae. *J. Asiat. Soc. Bengal*, 69(2(3)): 440-450.  
Alexander, H. G. 1979. A preliminary assessment of the role of the terrestrial decapod crustaceans in the Aldabran ecosystem. *Phil. Trans. R. Soc. Lond. B*, 286: 241-246.

Barnwell, F. H. 1982. A Philippine Land Crab Trap. *J. Crustac. Biol.*, 2: 202-206.  
Burggren, W. W. and B. R. McMahon. 1988. Biology of the land crabs. Cambridge University Press, Cambridge, New York, 479 pp.  
Cameron, J. N. 1981. Brief introduction to the land crabs of the Palau Islands: Stages in the transition to air breathing. *J. Exp. Zool.*, 218: 1-5.  
Carpenter, K. E. and V. H. Niem. 1998. Living marine resources of the Western Central Pacific. Vol. 2: Cephalopods, crustaceans, holothurians and sharks. *FAO species identification guide for fishery purposes, Rome*, 2: 687-1396.  
Chen T. 2012. *Reproductive ecology of Cardisoma carnifex (Brachyura) in Hengchun Peninsula, Taiwan* (Masters Thesis in Marine Biology). National Sun Yat-Sen University, Taiwan, 73 pp.  
Devi, S. S., J. C. E. Mendoza, R. Ravinesh, K. K. I. Babu, A. B. Kumar and P. K. L. Ng. 2019. On a collection of brachyuran crabs from Lakshadweep, Indian Ocean (Crustacea: Decapoda: Brachyura). *Zootaxa*, 4613: 477-501.  
Department of Environment and Forests, Andaman & Nicobar, 2020. (<http://ls1.and.nic.in/doi/ef/WebPages/Forest.html>).  
Doi, W., T. Muarakami, M. Yoshioka, A. Mizutani, S. Shimokawa and H. Kohno. 2018. Numerical analysis for dispersal and recruitment of pelagic larvae of the land crabs in Amitori Bay, Iriomote Island. *J. JSC Ser. B3*, 74: 462-467.  
Foale, S. 1999. Local ecological knowledge and biology of the land crab *Cardisoma hirtipes* (Decapoda: Gecarcinidae) at West Nggela, Solomon Islands. *Pac. Sci.*, 53: 37-49.  
Grubb, P. 1971. Ecology of terrestrial decapod crustaceans on Aldabra. *Phil. Trans. R. Soc. Lond. B*, 260: 411-416.  
Heidemann, F. and P. Zehmsch. 2016. The invisible architects of Andaman: Manifestations of aboriginal migration from Ranchi, in: Manifestations of history: Time, space, and community in the Andaman Islands. Primus Books, New Delhi, p. 122-138.  
Herbst, J. F. W. 1796. Versuch einer Naturgeschichte der Krabben und Krebse : nebst einer systematischen Beschreibung ihrer verschiedenen Arten. Bei Gottlieb August Lange, Berlin. II, plate XLI-Fig 1. 163 pp.  
Kannupandi, T., S. A. Khan, M. Thomas, S. Sundaramoorthy and R. Natarajan. 1980. Larvae of the land crab *Cardisoma carnifex* (Herbst) (Brachyura: Gecarcinidae) reared in the laboratory. *Indian J. Mar. Sci.*, 9: 271-277.  
Kronen, M. 2007. Chasing land crabs on Christmas Island. *SPC Women in Fisheries Information Bulletin*, 16: 21.  
Lai, J. C. Y., H. T. Shih and P. K. L. Ng. 2017. The systematics of land crabs of the genus *Gecarcoidea* and recognition of a pseudocryptic species, *G. humei*, from the eastern Indian Ocean (Crustacea: Decapoda: Gecarcinidae). *Invertebr. Syst.*, 31: 406-426.  
Lee, M. A. B. 1985. The Dispersal of *Pandanus tectorius* by the Land Crab *Cardisoma carnifex*. *Oikos*, 45: 169-173.  
Liu, H. C. and M. S. Jeng. 2007. Some reproductive aspects of *Gecarcoidea lalandii* (Brachyura: Gecarcinidae) in Taiwan. *Zool. Stud.*, 46: 347-354.  
Lyla, S., G. Manikantan and S. A. Khan. 2016. Proximate Composition of Edible and Potentially Useful Brachyuran Crabs of Parangipettai, Southeast Coast of India. *Inventi Rapid: Nutraceuticals*, 2017(1): 1-5.  
Maiti, S. 2004. The Karen - A lesser known community of the Andaman Islands (India). Presented at the Islands of the World VIII International Conference, Kimmen (Quemoy), Taiwan, 15 pp.  
Matthews, E. 2002. Learning about land crabs in Palau. *SPC Women in Fisheries Information Bulletin*, 11: 15-16.  
Mohanty, N. P. and R. Chakravarty. 2018. Ethno-ornithology of Karen and Ranchi inhabitants of the Andaman Islands: An annotated checklist of local names and etymology. *Indian BIRDS*, 14: 73-78.  
Morgan, S. G. and J. H. Christy. 1995. Adaptive significance of the timing of larval release by crabs. *Am. Nat.*, 145(3): 457- 479.  
Ng, P. K. L. and H. T. Shih. 2014. The systematics of the land crabs of the *Discoplax hirtipes* (Dana, 1851) species-group (Crustacea: Decapoda: Brachyura: Gecarcinidae), with description of a new species from the eastern Indian Ocean. *Raffles B. Zool.*, 30: 109-135.  
Quinn, N. J., B. L. Kons, K. Dible and U. Meischner. 1991. Reproductive behaviour of *Cardisoma carnifex* (Herbst, 1794) (Brachyura: Gecarcinidae) at Lizard Island, Great Barrier Reef. *Mem. Queensl. Mus.*, 31: 399.  
Sankaranikutty, C. 1962. On decapod brachyura from the Andaman and Nicobar Islands. 3 Families: Calappidae, Leucosiidae, Parthenopidae, Maididae and Gecarcinidae. *J. Mar. Biol. Ass. India*, 4: 151-164.  
Silas, E. G. and C. Sankaranikutty. 1960. On the castle building habit of the crab *Cardisoma carnifex* (Herbst) (Family gecarcinidae) of the Andaman Islands. *J. Mar. Biol. Ass. India*, 2: 237-240.  
Subang Jr, B. P., S. R. G. Juan, G. F. C. Ventura and N. M. Aspe. 2020. An Annotated Checklist to the Commonly Harvested Crabs (Crustacea: Decapoda) from Marine and Brackish Water Ecosystems of Palawan, Philippines. *J. Environ. Aquat. Res.*, 5: 61-82.